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ABSTRACT

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Running Head: PREKINDERGARTEN EARLY INTERVENTION AND 4TH GRADE ACHIEVEMENT

Comparing fourth-grade math and reading achievement of children who did and did not participate in Florida's statewide Prekindergarten Early Intervention Program

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Abstract

This study assessed the effects of participating in Florida's Prekindergarten Early Intervention Program (PKEI) on 4th grade math and reading standardized norm referenced test scores and incidence of retention. PKEI serves mostly four-year-old children from families whose income falls below the federal poverty level. Study subjects were all children who started kindergarten in 1993-94 and remained in Florida's public schools for the following four years. (N =75,025). Results of a logistic regression analysis indicated that African-American, Hispanic, and female students who had participated in PKEI had significantly higher odds of being in the highest test score outcome category for both math and reading, relative to their counterparts who had not been in PKEI. These same groups of PKEI participants had significant lower odds of being excluded from taking the test (on the grounds of being assigned to exceptional student education) and of being retained. PKEI participation did not appear to benefit low income White students or males.

[157 words]

Comparing fourth-grade math and reading achievement of children who did and did not participate in Florida's statewide Prekindergarten Early Intervention Program

Introduction

Since the inception of Head Start, federal and state programs serving economically disadvantaged four-year-olds have consistently been challenged to demonstrate that early education leads to satisfactory academic performance in elementary school. For example, two recent General Accounting Office reports (1997, 1998) concluded that Head Start research to date has not systematically evaluated the program's long-term impact on children's cognitive skills. In response to the Government Performance and Results Act of 1993 (PL 103-62), the Administration for Children and Families (1999) launched a series of initiatives, both within the Department of Health and Human Services and in collaboration with the Department of Education, to measure the enduring educational consequences of Head Start participation. Commissioned studies include the Early Childhood Longitudinal Study Kindergarten Cohort which will follow 3,000 former Head Start children to fifth grade.

When the state of Florida passed its Prevention, Early Assistance, and Early Childhood Act in 1989 authorizing a prekindergarten early intervention (PKEI) program for low-income four-year-olds, it built into statute an on-going, third-party evaluation of program effectiveness. This paper summarizes the findings from the fourth in a series of annual reports prepared by an independent evaluation contractor.

Description of Florida's PKEI program

Eligibility. The legislation authorizing the PKEI program intended the program to "serve as preventive measures for children at risk of future school failure" (Florida Statutes, Section 230.2305, 1989). At least 75% of the children served were to be economically disadvantaged four-year-olds. The remainder would be comprised of economically disadvantaged three-year-olds, non-economically disadvantaged three- and four-year- olds who had been abused, prenatally exposed to harmful drugs, were in foster homes, or who were marginal in terms of qualifying for exceptional student education.

Features. The program calls for a developmentally appropriate curriculum that adheres to current nationally recognized recommendations for high-quality preschool programs (Bredekamp & Copple, 1997; Epstein, Schweinhart, & McAdoo,1996). To that end, the program must operate six hours a day for 180 days, and districts are encouraged to make reasonable efforts to provide extended day and extended year services. The maximum number of children per classroom is capped at twenty. Instructional staff ratio is set at 1 adult for every 10 children. Teachers must be certified in early childhood education (for sites administered by school districts) or possess a two-year Child Development Associate credential (for sites administered by community-based organizations or subsidized child care providers). Other elements in the enabling legislation considered necessary for readying children to succeed in school include health screenings, parental involvement, and family support services coordination.

Scope. During the 1998-99 school year, the PKEI program served nearly 30,000 children on a budget of 97 million dollars (Blank, Schulman, & Ewen, 1999). This sum breaks out to $3,233 per student, or about $500 less than the average annual cost of child care reported for 4-year olds in Florida (Adams & Schulman, 1998).

This paper examines the performance of one statewide, school year cohort of students who began together in kindergarten and were tested five years later on math and reading standardized tests. It compares the scores of those who had participated in Florida's PKEI program to those who had not, both groups matched on family income.

Methods

Sample description

The study sample consisted of all children who satisfied the following criteria:

1. Started Kindergarten in a Florida public school in 1993-94, and remained in the Florida public school system for the next five years.
2. Met eligibility requirements for free or reduced lunch subsidy (i.e. family income below federal poverty level).
3. Had not participated in Florida's Prekindergarten Program for Children with Disabilities.

There were 75,025 children in the Florida Department of Education's automated student database that satisfied the above requirements. Of this kindergarten cohort, 12,098 had participated in PKEI in 1992-93 The remaining 62,927 constituted the comparison group. Table 1 shows the distribution of PKEI participants and non-

participants across levels of ethnicity and gender, two other variables that were considered potential correlates of outcome. However, not all children in the two groups were tested. We distinguished between those who were not tested because either they had been assigned to Exceptional Student Education (ESE) or had been retained, and those who were not tested for unknown reasons. This latter group was deleted from the analyses.

Table 2 presents information on the subset of children who had never been retained. It gives their distribution into ESE (yes, no) by participation group (PKEI, no PKEI) and test status (taken, not taken). The table shows that for math, 1,343 (254 + 1,089) children were not tested and were not in ESE other than part-time speech and language. For reading 1,277 (254 + 1.023) were similarly not tested and not in ESE other than part-time speech and language. It is not known whether these individuals could have been tested or not. In contrast, we assumed that the 2,487 (529 + 1,958) and 2,514 (533 + 1,981) children in math and reading respectively who were not tested and were in ESE could not have been tested because of low capacity. The 2,487 and 2,514 were included in our study sample for math and reading respectively, while the 1,343 and 1,277 were not.

Thus, the study sample analyzed for math consisted of all children who were tested (n = 503 + 5,432 + 2,048 + 24,707, or 32,690), those who were not tested because of presumed incapacity (n = 2,487), and those who were not tested because they had been retained at least once between kindergarten and 4th grade (n = 19,722),

for a total of 54,899. Similarly, the study sample analyzed for reading consisted of all children who were tested (n = 510 + 5463 + 2057 + 24,925, or 32,955), those were not tested because of presumed low capacity (n = 2,514), and those who were not tested because of retention between kindergarten and 4th grade (n=19,722), for a total of 55,191.

Measures

Response variable. The main outcome of interest was achievement on the Reading and Mathematics subsections of any one of five norm-referenced tests (NRT) that were administered by school districts during the 1997-98 academic year. All districts reported students' test results to the state department of education in the form of National Percentile Ranks. While the normative sample for these tests (e.g., California Achievement Test, Terranova, Stanford-8) is different, it was possible to treat students' performance on different standardized tests as equivalent by aggregating performance to the quartile level. It was highly unlikely that any student's position within a quartile range would vary significantly across test instruments.

The response variable consisted of five levels:

1. Test score above the third quartile, 76 - 99.
2. Test score between the median and third quartile, 51 - 75.
3. Test score between the first quartile and the median, 26 – 50.
4. Test score was less than or equal to first quartile, 1 - 25.
5. Test not taken due to child assigned to ESE (other than part- time

speech and language) or to retention.

This variable was used instead of raw test score to avoid a bias that could result if the program were successful in moving children who otherwise would not have been tested into the testable but low scoring range, while comparable children in the comparison group remain untested.

Explanatory Variables. Correlates of achievement analyzed were race/ethnicity, gender, and PKEI participation. A race/ethnic group initially categorized as "Other" comprised those who were neither African-African nor White. It was overwhelmingly Hispanic and so relabeled, though it contained small numbers of Asians, Pacific Islanders, and Native Americans.

Statistical methods

Since the response categories have a natural ordering, a cumulative logistic regression analysis was performed, using race/ethnicity, gender, and PKEI participation as explanatory variables. This technique estimates the effects of the explanatory variables on the odds of being in:

1. The highest test score category versus the remaining categories
2. The two highest test score categories versus the remaining categories
3. The three highest test score categories versus the remaining categories
4. The tested versus the not tested category.

An additional analysis of retention was done using logistic regression with the response variable being whether or not a student was ever retained.

Results

For both math and reading test score outcomes, there were significant interactions involving race/ethnicity. Thus, separate analyses were carried out for each of the three race/ethnicity groups.

Math Achievement

Table 3 shows that African-American students who participated in PKEI had significantly higher odds of being in the highest, two highest, and three highest math test score categories than African-American who did not participate in PKEI. Table 4 shows similar results for Hispanic students. Table 5 shows that White students who were in PKEI did not score in the highest or two highest math test score categories compared to White students who had not participated in PKEI.

PKEI participants across all three race/ethnicity groups had significantly higher odds of being in the testable category compared to their racial/ethnic counterparts who did not participate in PKEI (Tables 3-5).

Female PKEI participants across all three race/ethnic categories had significantly higher odds of being in the highest, two highest, and three highest math test score categories than male PKEI participant counterparts (Tables 3-5). PKEI females across all three race/ethnic categories also had significantly higher odds of being in the testable category compared to PKEI males (Tables 3-5).

Reading Achievement

Table 6 indicates that African-American students who participated in PKEI had significantly higher odds of being in the highest, two highest, and three highest reading test score categories than African-American who did not participate in PKEI. Table 7 shows similar results for Hispanic students. Table 8 shows that White PKEI students did not have significantly higher odds of scoring in the top three reading test score categories compared to White non-PKEI students.

Female PKEI participants across all three race/ethnic categories had significantly higher odds of being in the highest, two highest, and three highest reading test score categories than male PKEI participants (Tables 6-8). PKEI females across all three race/ethnic categories also had significantly higher odds of being in the testable category compared to PKEI males.

Retention

As with the NRT score outcomes, there was a significant interaction involving retention and race/ethnicity. For all three race/ethnic groups, females and PKEI participants had significantly lower odds of being retained than males and those who did not participate in PKEI. Table 9 shows that African-American non-PKEI participants were nearly three times more likely to be retained than were African-American PKEI participants. Among Hispanics the likelihood of retention was nearly seven times greater for non-participants.

Discussion

For African-American and Hispanic race/ethnicity groups, PKEI participation had a significant positive effect on the five-level outcome variable (three highest NRT score categories, being tested at all, and retention). In fact, the estimated odds of being in the highest NRT achievement quartile were always larger for PKEI participants relative to non-participants for these two groups. For all race/ethnic categories, PKEI children were more likely to be tested (that is, not excluded because of assignment to exceptional student education) than their low-income non-PKEI counterparts. Hence, there are grounds for concluding that PKEI participation had a substantial positive effect on math and reading achievement at fourth grade.

The finding that White students did not benefit from PKEI participation as much as African-American and Hispanic students is difficult to explain from the available data. One possible explanation for the null effect is that many parents of preschool children view the PKEI program as primarily serving minority students. Many low-income White parents choose to enroll their children in faith-based, subsidized childcare programs, instead of the public school-based PKEI program. Those White children who are enrolled in PKEI probably represent the most disadvantaged segment of low-income White families.

The results of the retention analysis indicated that PKEI had a preventive effect across all three race/ethnic groups. This protective effect was demonstrated by the comparison of the proportion of PKEI and non-PKEI children in the study sample who

had ever experienced academic retention. Twenty nine percent of non-PKEI children were retained between kindergarten and fourth grade, compared to 13% of PKEI children.

Summarizing, it can be inferred from the sample analyzed in this study that the beneficial effect of PKEI on math and reading achievement was mediated through its effect on retention. Students who participated in PKEI were less likely to be retained, and because they were not retained, they were more likely to be eligible to take, and to score higher on, standardized achievement tests at 4th grade than students who had not participated in PKEI.

A great deal of previous research has already identified deleterious effects of retention, either prospectively through its association with ensuing behavior problems and eventually early school leaving (Grissom & Shepard, 1989; Gottfriedson, Fink, & Graham, 1994; Roderick, 1994) or retrospectively through its association with low maternal education and male gender (Byrd and Weitzman, 1994).

If the analysis had been restricted to just the children who took the 4th grade NRT tests, the true effect of PKEI would have been masked. The largest success of PKEI was manifested in the higher percentage of children reaching fourth grade on track, that is, without ever having been retained. This absence of retention indicates a greater level of academic success of PKEI participants in elementary school. It also emphasizes that NRT scores should not be the sole measure of achievement when comparing the performance of programs, schools, counties, or states. The percentage

of children taking the test is also important. If number of children not taking the test is not reported in some fashion along with test score results, then an incomplete and potentially misleading picture of success may result.

It should be noted, however, that a fully accurate estimate of the effect of PKEI participation may not have been observed because children categorized as not in PKEI potentially could have been participants in other federally-funded intervention programs such as Head Start and Even Start. Thus, the non-participant comparison group in this study was probably contaminated by children who had, in fact, benefited from other interventions, thus reducing the measured effect of PKEI. Possibly a larger effect would have been observed if a true non-intervention control group had been available for comparison.

This study was not designed to answer the question: *how* does attending prekindergarten equip children to perform better on 4th grade achievement tests? Nonetheless, it may be worthwhile to extend the relevance of this research to practice by speculating on some possible explanations of the mechanisms through which improved performance is likely to occur. First are the health screenings routinely offered in preschool programs. The use of diagnostic tests such as the DIAL-R and the Ages and Stages Questionnaire can result in early detection of children who have physical or mental impairments. As soon as a problem with perception, coordination, or cognition is assessed, the child can be referred for therapy or assistive technology (e.g., hearing aids, glasses, etc). This proactive sentinel aspect of early intervention means

that the critical pathways for learning do not become obstructed by undiagnosed impediments.

A second mechanism that may contribute to higher achievement of prekindergarten participants is the education that is offered to their adult caregivers in child development and parenting. Conveying information about developmental milestones and interactional strategies can have the effect of elevating the educational and behavioral expectations that family members entertain for their children. Through observing how staff teach and play with children, caregivers become exposed to the standards under which preschool classrooms operate.

The third mechanism is closely related to the second in that it also has to do with expectations but references instead the child's early exposure to adult instruction and peer interchange. Prekindergarten prepares children for the academic and social demands of schooling by initiating them into the role of students. Multidimensional values associated with learning such as promptness, persistence, and evaluation are first communicated formally in preschool classroom settings.

In fairness, it should be mentioned that many early childhood educators object to the conception of prekindergarten as exclusively preparation for the rigors of schooling. Rather they see it as a societal response to changes in the workplace and family, offering children a safe and stimulating place to explore which may only indirectly impact subsequent scholastic performance. Whether one understands the preschool experience as providing early skill acquisition or surrogate nurturance, the good news,

at least for low-income parents in Florida, is that participation in PKEI lowers their children's risk of having to repeat a grade.

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Table 1

Description of Study Sample Used to Assess the Effects of PKEI on Math and Reading Standardized Test Scores

Explanatory Variables	**Total**		**PKEI**		**No PKEI**	
Race/ethnicity	**N**	**%**	**N**	**%**	**N**	**%**
African-American	31247	41.6	6383	52.8	24864	39.5
Hispanic	16941	22.6	2398	19.8	14543	23.1
White	26837	35.8	3317	27.4	23520	37.4
Gender						
Male	38267	51.0	6006	49.6	32261	51.3
Female	36758	49.0	6092	50.4	30666	48.7

Table 2

Testing Status of Children in Study Sample Who Were Not Retained Between Kindergarten and 4th grade, by PKEI Participation and ESE Classification

Standardized Norm Referenced Test—4th Grade Math

	PKEI				No PKEI			
	Tested		Not tested		Tested		Not tested	
	N	%	N	%	N	%	N	%
ESE								
Yes	503	8.48	529	67.56	2048	7.65	1958	64.26
No	5432	91.52	254	32.44	24707	92.35	1089	35.74

Standardized Norm Referenced Test—4th Grade Reading

	PKEI				No PKEI			
	Tested		Not tested		Tested		Not tested	
	N	%	N	%	N	%	N	%
ESE status								
Yes	510	8.54	533	67.73	2057	7.62	1981	65.95
No	5463	91.46	254	32.27	24925	92.38	1023	34.05

Table 3

Odds Ratios for African-American Students' 4th Grade NRT Math Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.31	(1.19, 1.43)
PKEI Y/N	1.40	(1.25, 1.56)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.40	(1.31, 1.50)
PKEI Y/N	1.52	(1.41, 1.64)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.49	(1.41, 1.58)
PKEI Y/N	1.72	(1.61, 1.85)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.52	(1.44, 1.60)
PKEI Y/N	2.40	(2.23, 2.59)

Table 4

Odds Ratios for Hispanic Students' 4th Grade NRT Math Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.23	(1.08, 1.39)
PKEI Y/N	2.41	(2.03, 2.85)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.15	(1.05, 1.27)
PKEI Y/N	2.68	(2.34, 3.08)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.29	(1.18, 1.41)
PKEI Y/N	3.52	(3.08, 4.03)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.26	(1.16, 1.37)
PKEI Y/N	5.10	(4.40, 5.90)

Table 5

Odds Ratios for White Students' 4th Grade NRT Math Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.07	(1.00, 1.14)
PKEI Y/N	1.02	(0.93, 1.12)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.27	(1.20, 1.34)
PKEI Y/N	0.94	(0.87, 1.02)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.48	(1.40, 1.56)
PKEI Y/N	1.11	(1.02, 1.20)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.64	(1.55, 1.74)
PKEI Y/N	1.25	(1.14, 1.36)

Table 6

Odds Ratios for African-American Students' 4th Grade NRT Reading Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.57	(1.36, 1.82)
PKEI Y/N	1.36	(1.15, 1.61)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.66	(1.54, 1.80)
PKEI Y/N	1.38	(1.26, 1.51)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.71	(1.62, 1.81)
PKEI Y/N	1.66	(1.55, 1.78)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.53	(1.45, 1.61)
PKEI Y/N	2.36	(2.19, 2.54)

Table 7

Odds Ratios for Hispanic Students' 4th Grade NRT Reading Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.25	(1.04, 1.51)
PKEI Y/N	1.70	(1.31, 2.20)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.36	(1.22, 1.52)
PKEI Y/N	2.04	(1.74, 2.39)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.39	(1.27, 1.52)
PKEI Y/N	2.84	(2.49, 3.24)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.26	(1.16, 1.37)
PKEI Y/N	5.06	(4.37, 5.85)

Table 8

Odds Ratios for White Students' 4th Grade NRT Reading Scores

A. Highest Test Score Category Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.23	(1.14, 1.32)
PKEI Y/N	0.92	(0.82, 1.03)

B. Highest Two Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.37	(1.30, 1.45)
PKEI Y/N	0.99	(0.91, 1.07)

C. Highest Three Test Score Categories Versus Remaining Categories

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.60	(1.51, 1.68)
PKEI Y/N	1.09	(0.99, 1.17)

D. Test Taken Versus Not Taken

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender F/M	1.65	(1.56, 1.75)
PKEI Y/N	1.29	(1.17, 1.41)

Table 9

Odds Ratios for Retention among African-American, Hispanic, and White Students

A. African-American

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender M/F	1.29	(1.22, 1.36)
PKEI N/Y	2.96	(2.73, 3.21)

B. Hispanic

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender M/F	1.16	(1.09, 1.24)
PKEI N/Y	6.87	(5.95, 7.93)

C. White

Factor	Estimated Odds Ratio	95% Confidence Interval
Gender M/F	1.46	(1.38, 1.55)
PKEI N/Y	1.38	(1.26, 1.52)